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AIR POLLUTION CONTROL DISTRICT
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"REVISED"

NOVEMBER 29, 1977

TO: Marshall A. Kent, Chairperson and Members of the Advisory Council

FROM: Scott Lynn, Chairperson
Technical Committee

RE: Storage of Organic Liquids

The Technical Committee recommends that the Council send the following report on this subject to the Board.

The Technical Committee of the Advisory Council met on November 18 to discuss suitable revisions of the District's regulation concerning storage of organic liquids. Mr. Alan Goodley of the ARB staff presented the ARB's position at that meeting. The Advisory Council has reached the following conclusions regarding the key provisions of the regulation that the ARB has proposed for the District: The ARB presented data from a recent experimental study that show that installation of secondary seals on floating-roof tanks reduces emission of organic vapors significantly. The Council concurs. The ARB staff made a cost/benefit analysis of expected emission reductions and concluded that a secondary seal need not be required when the organic liquid in a tank has a vapor pressure of less than 0.1 bar (1.5 psi) absolute. The Council concurs. The ARB proposes that vapor recovery systems for fixed-roof tanks be required to control 95% of emissions even though this may be less control that is achieved by a floating-roof tank. The Council concurs. The ARB proposes that very stringent requirements be set for the allowable gap for the primary seals of floating-roof tanks equipped with secondary seals. The Council disagrees for the following reasons:

1. The Council finds that the available data show very little change in emissions from varying the gap width of the primary seal.

2. The Council notes that the ARB staff has done no cost/benefit analysis of the emissions reduction that such a requirement might provide and believes that the cost per pound of reduced emissions would be large.

3. The Council notes further that this requirement is logically inconsistent in terms of cost and allowable emissions with the ARB position on vapor pressure and vapor recovery systems.

The Council therefore recommends that the gap criteria for shoe-type primary seals be set on the basis of the experimental data to which the ARB referred. Finally, the ARB proposes that riveted

tanks be treated differently than welded tanks in the regulation. The Council notes that the experimental data show that essentially the same emissions result from either type of tank when essentially the same primary and secondary seal gap configurations are applied to both. The Council therefore recommends that the same seal gap criteria be used for both types of tank.

Mr. Goodley presented three documents to the Technical Committee at the meeting of November 19. One was an ARB staff report dated March 25, 1977 (3/25 Report). The second was an ARB Hearing Officer's Report by Dr. Alvin S. Gordon dated May 31 (5/31 Report). The third, appended to this report, was a bar chart entitled "Effect of Primary and Secondary Seal Gaps on Floating Roof Tank Emissions". All three documents rely heavily or exclusively on a recent experimental study by Chicago Bridge and Iron (CBI).

The cost/benefit analysis of secondary seals appears on pp. 10 and 11 of the 3/25 Report. It is based on CBI data for a propane - octane mixture having a true vapor pressure of 5 psi absolute. Emissions for mixtures having other vapor pressures were taken from Figure 4, 3/25 Report, which is appended here. The basic cost/benefit analysis is derived from the cost of the secondary seal, the value of propane lost, and the rate of loss from a tank holding the 5 psia mixture. The ARB staff concluded that the cost of secondary seals would be excessive for mixtures having a vapor pressure of less than 1.5 psia. These results are shown in Figure 5, 3/25. The Council agrees with the cost/benefit analysis. However, it will be noted from Figure 4, 3/25 Report, that emissions from a tank containing a mixture with a vapor pressure of 1 psia are expected to be about 37% of those from a tank with a 5 psia mixture. (The data in Figure 4 are for a tank having only a primary seal).

On pp. 8 and 9 of the 5/31 Report, Dr. Gordon recommends that a recovery of 95% be required for vapor recovery systems for fixed-roof tanks, even though this may allow a higher rate of emissions than some floating-roof tanks of equal storage capacity. On page 33 of the 3/25 Report, the ARB staff makes a similar recommendation based on cost considerations. Calculation by the District staff (APCO Memo of November 2, 1976), based on the empirical formulas of the American Petroleum Institute given in AP 42, show that a floating-roof tank equipped only with a primary seal reduces emission by 89 to 97% relative to a fixed-roof tank without vapor recovery. The Advisory Council agrees with the ARB recommendation on vapor recovery systems on the basis of cost/benefit analysis. The Council notes, however, that emissions from such systems will be large relative to those from comparable floating-roof tanks equipped with secondary seals.

The bar chart presented by Mr. Goodley shows the effect of secondary seals on emissions from floating-roof tanks equipped with torroidal and shoe-type primary seals. In three cases the tanks were of welded construction, in one case riveted. Numbers from 1 to 11 have been added to the bars in Mr. Goodley's chart to facilitate reference.

For each of the four cases shown in the bar chart the primary seal has a single gap configuration. One bar in each case shows

the rate of emission in the absence of a secondary seal. The other bars in each case show the rates of emission for various secondary gap configurations. In response to several direct questions Mr. Goodley stated that the bar chart is an accurate summary of the CBI findings of the influence of primary and secondary seal gaps on emissions.

Examination of the bar chart reveals a number of striking findings. One is that in the absence of a secondary seal a torroidal seal is relatively ineffective (bar #1). The second is that when the configuration of the secondary gap is held constant a large change in the primary gap has little effect (compare bars #5 and #7, and bars #8 and #11). From the data presented in the bar chart it is apparent that a tight -fitting secondary seal is quite effective in reducing emissions from any floating-roof tank. It appears from these data to be relatively unimportant whether the tank is welded or riveted, or whether the primary seal gap is relatively small or relatively large. The use of a torroidal primary seal appears to result in higher emissions than occur with a shoe-type seal.

In the 3/25 Report the ARB staff noted the low correlation that has been found between primary seal gap and tank emissions for shoe-type seals even in the absence of secondary seals (pp 28 and 29). The data on existing tanks in the District presented in Table II of the 3/25 Report indicate that many with shoe-type primary seals would not meet a regulation requiring a seal gap not exceeding 1/8 inch for 85% of the cumulative circumference of the tank. It seems likely that many would not meet such a criterion for 60% of the cumulative circumference. The criterion is clearly impossible for riveted tanks. On the other hand, most of the tanks with torroidal primary seals would meet the proposed criteria.

The ARB staff has not presented a cost/benefit analysis for the emission reduction that would be derived by requiring the primary seal gap for shoe-type seals to be no greater than 1/8 inch for 60% of the cumulative circumference. Neither has the Advisory Council. However, the data that are available show a very small effect of primary seal gap on emissions from a tank equipped with a secondary seal. It seems highly unlikely that this stringent primary seal gap requirement would be found cost effective in the light of the findings of the ARB staff for vapor pressure and vapor recovery. If applied literally this requirement would necessitate the replacement of all riveted tanks, at a cost of many million of dollars. The Advisory Council therefore recommends that the the CBI data be used as the basis for the primary seal gap criterion for the shoe-type primary seals, as shown in the suggested regulation below. It is anticipated that relaxing the regulation in this way will change the rate of emission of organic vapors in the District by less than 0.1%. It is felt that substantially the same regulation can be applied to both welded and riveted tanks.

As suggested by Mr. Goodley, floating-roofs of the floating-pan type should be insulated to prevent excessive heating of the oil by the sun. He further stated that it is not the intention of the ARB to require massive rebuilding of organic storage tanks. The Council feels that the modifications it has

suggested for the proposed regulation will avoid the implication that massive rebuilding would be required.

SL:rbz

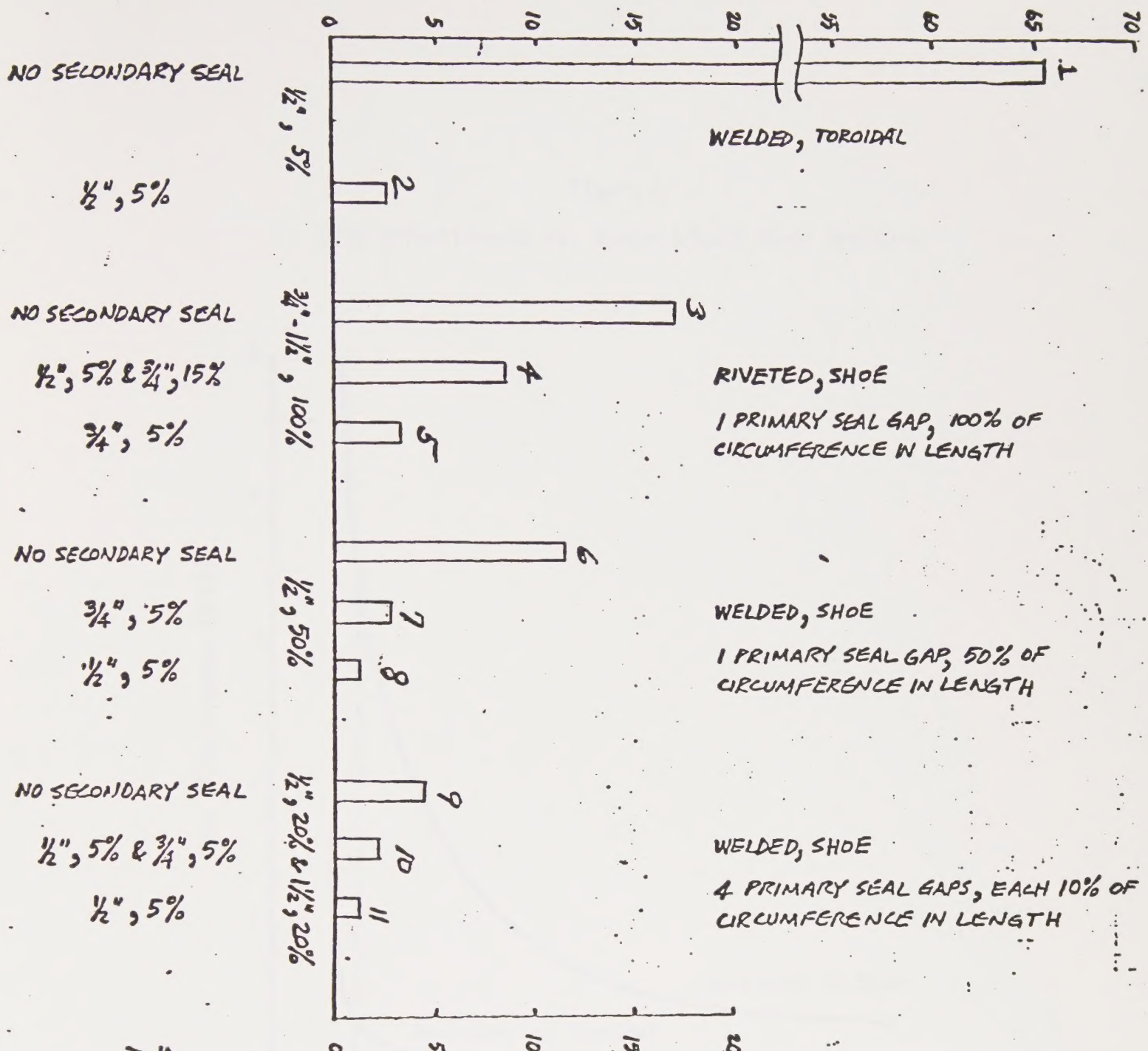
BAR CHART PRESENTED TO TECH. COM. BY MR. ALAN GOODLEY 11/18/77

THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

Project _____ Sheet _____

Feature _____ Designed _____ Date _____

Item _____ Checked _____ Date _____



EFFECT OF PRIMARY & SECONDARY SEAL GAPS ON FLOATING ROOF TANK EMISSIONS

DWR 122-C (9-68)

Figure 5

Cost Effectiveness vs. Stored Liquid Vapor Pressure

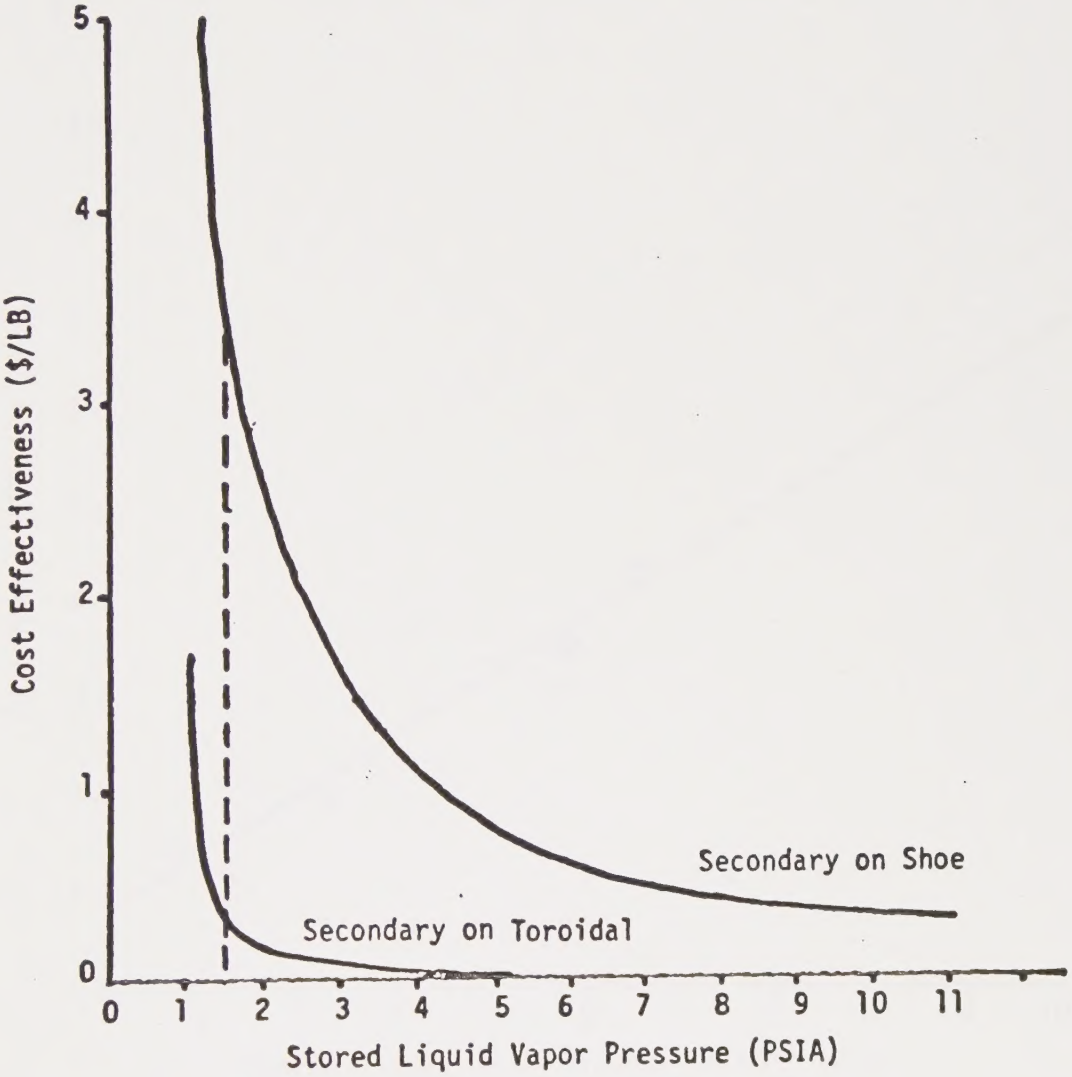


Figure 4

Emissions vs. Stored Liquid Vapor Pressure